Design and fabrication of Suzuki-phase photonic bandgap lattices and microcavities for the near Infrared

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We have studied and fabricated 2D Suzuki-phase lattices of holes in dielectric [1,2]. Plane wave expansion (PWE) calculations have been performed to obtain the photonic bands, showing for the TE mode a double photonic gap for normalized frequencies ω between 0.20 and 0.35 with two well-defined photonic bands inside it. These bands are very flat along the reciprocal lattice and it can be used to enhance the light interaction with the semiconductor material (InGaAsP) due to their low group-velocity for a wide range of k-vectors. We have also studied different cavities obtained by elimination of 1 or 2 holes, obtaining defect levels between the bands with localized modes. Finally, we have fabricated a Suzuki-phase lattice and measured its reflectivity spectrum between ω=0.20 and ω=0.35, obtaining well-pronounced Fano line shapes[3] for expected values.

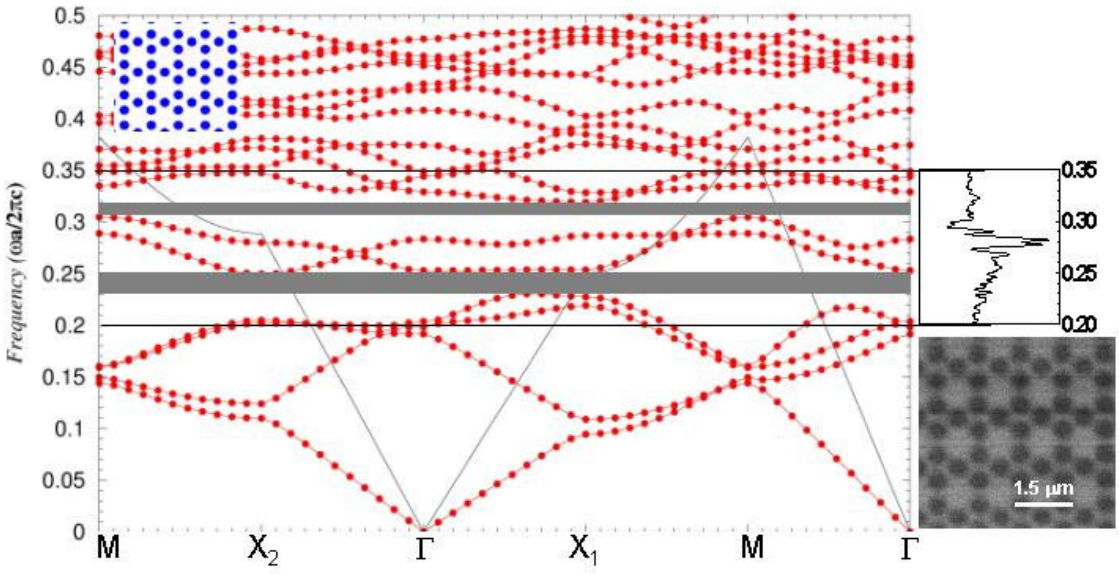

Fig.1. Photonic bands for the TE mode of the Suzuki phase lattice calculated by 2D PWE with an effective index of n=3.13. Inset shows the geometry of the lattice. Two gaps appear for normalized frequencies between 0.2 and 0.35 with two very flat bands between them. The SEM picture shows the fabricated structure with a=650 nm and r/a=0.33. Panel on the right shows the reflectivity FTIR spectrum at near normal indicence measured in the fabricated structure for normalized frequencies between 0.2 and 0.35.

[1] A.L.Reynolds et al. IEEE Trans. on Microwave Theory and Techniques, vol. 49, no. 10, 1860, (2001)
[2] J. Sánchez-Dehesa et al. Proceedings of SPIE Vol. 4655 (2002)
[3] U. Fano, Phys. Rev. **124**, 1866 (1961).

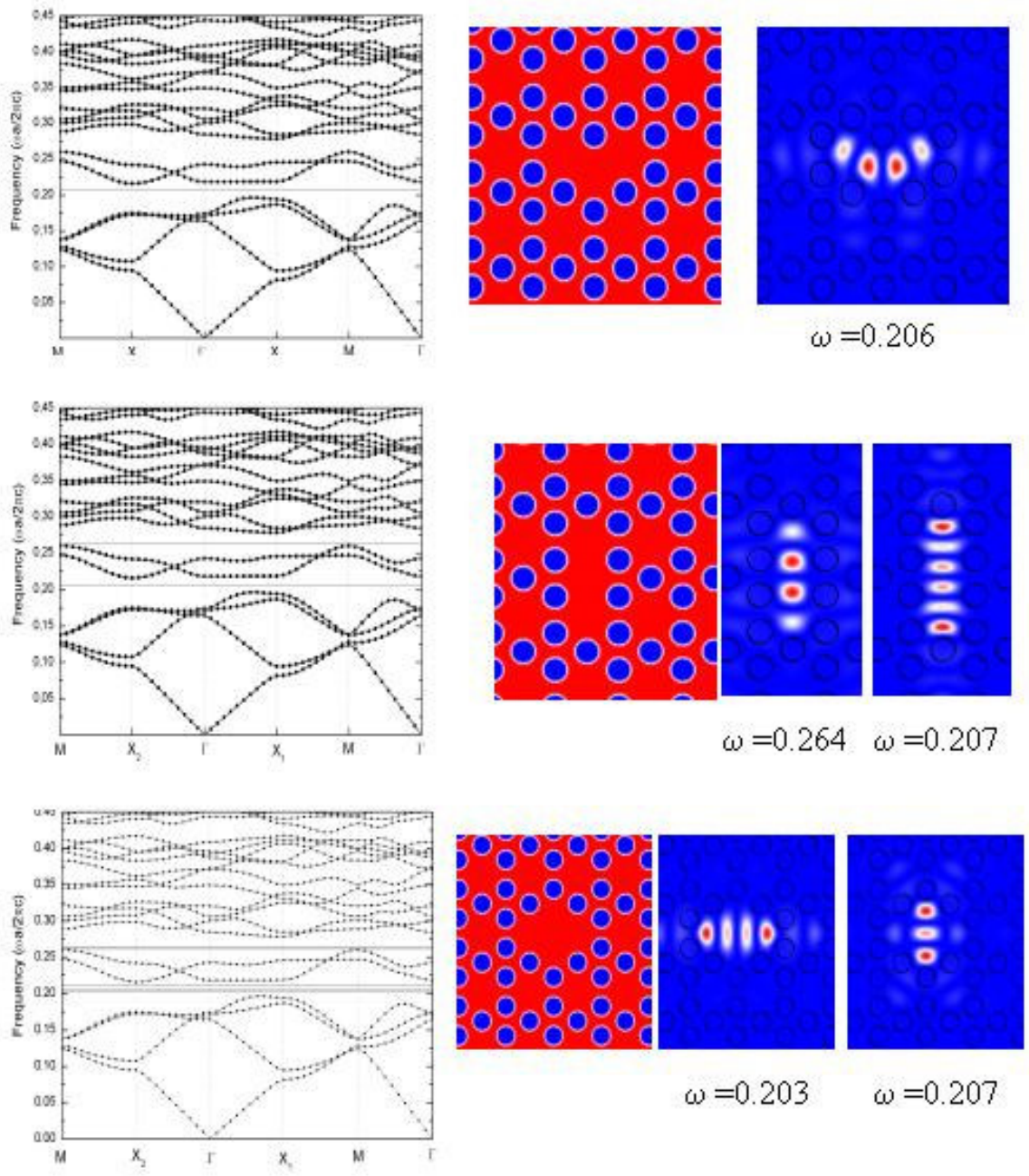

Fig.2. Different cavities for the Suzuki phase lattice. Figure shows the geometry of the cavity, the level generated inside the gap and $|H(x,y)|^2$ for selected frequencies.